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(71) Applicant: QUALCOMM INCORPORATED [US/US]; 6455 Lusk Boulevard, San Diego, CA 92121 (US).

(72) Inventors: WILLENEGGER, Serge; Vallon 14, CH-1400 Yverdon-Les-Bains (CH). JOU, Yu-Cheun; 9979 Riverhead Drive, San Diego, CA 92129 (US).

(74) Agents: MILLER, Russell, B. et al.; Qualcomm Incorporated, 6455 Lusk Boulevard, San Diego, CA 92121 (US).

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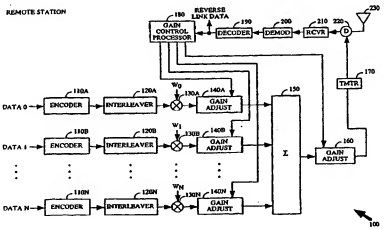

(57) Abstract

A power control subsystem (100) for a remote station (1) which transmits a reverse link signal comprising a plurality of subchannel signals, the power control subsystem comprising a receiver (210) and plural gain adjusters (140A, 140B, 140N). The receiver (210) is arranged to receive a power control message and to provide a plurality of gain values based on said power control message. Each of said gain adjusters is arranged to receive a corresponding subchannel signal and a corresponding gain value and to adjust the gain of said subchannel signal in accordance with said gain value, whereby the transmit power of each said subchannel signal can be independently adjusted based upon a received power control message. Thus, when a transmitting station (2) generates a channel made up of a sum of subchannels, each subchannel or group of subchannels is amplified with a unique gain value that is varied in accordance with subchannel power control messages. The subchannel power control messages are generated subsequent to monitoring and calculating metrics based on that received subchannel.

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A POWER CONTROL SUBSYSTEM

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates to a power control subsystem. More specifically, the present invention relates to a power control subsystem for use in a base station of a wireless communication system in which a remote station transmits a reverse link signal comprising a plurality of subchannel signals.

II. Description of the Related Art

In a code division multiple access (CDMA) spread spectrum communication system, a common frequency band is used for communication with all base stations within that system. An example of such a system is described in the TIA/EIA Interim Standard IS-95-A entitled "Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System", incorporated herein by reference. The generation and receipt of CDMA signals is disclosed in U.S. Patent No. 4,401,307 entitled "SPREAD SPECTRUM MULTIPLE ACCESS COMMUNICATION SYSTEMS USING SATELLITE OR TERRESTRIAL REPEATERS" and in U.S. Patent No. 5,103,459 entitled "SYSTEM AND METHOD FOR GENERATING WAVEFORMS IN A CDMA CELLULAR TELEPHONE SYSTEM" both of which are assigned to the assignee of the present invention and incorporated herein by reference.

Signals occupying the common frequency band are discriminated at the receiving station through the spread spectrum CDMA waveform properties based on the use of a high rate pseudonoise (PN) code. A PN code is used to modulate signals transmitted from the base stations and the remote stations. Signals from different base stations can be separately received at the receiving station by discrimination of the unique time offset that is introduced in the PN codes assigned to each base station. The high rate PN modulation also allows the receiving station to receive a signal from a single transmission station where the signal has traveled over distinct propagation paths. Demodulation of multiple signals is disclosed in U.S. Patent No. 5,490,165 entitled "DEMODULATION ELEMENT ASSIGNMENT IN A SYSTEM CAPABLE OF RECEIVING MULTIPLE SIGNALS" and in U.S. Patent No. 5,109,390 entitled "DIVERSITY RECEIVER

IN A CDMA CELLULAR TELEPHONE SYSTEM", both of which are assigned to the assignee of the present invention and incorporated herein by reference.

The IS-95 Over-the-Air (OTA) Interface Standard defines a set of RF signal modulation procedures for implementing a digital cellular telephone system. The IS-95 standard, and its derivatives, such as IS-95A and ANSI J-STD-008 (referred to collectively as the IS-95 standard), are promulgated by the Telecommunications Industry Association (TIA) to insure the operability between telecommunications equipment manufactured by different vendors.

The IS-95 standard has received enthusiastic reception because it uses the available RF bandwidth more efficiently than previously existing cellular telephone technologies. This increased efficiency is provided by using CDMA signal processing techniques in combination with extensive transmit power control to increase the frequency reuse of a cellular telephone system.

FIG. 1 illustrates a digital cellular telephone system configured in a manner consistent with the use of IS-95. During operation, telephone calls and other communications are conducted by exchanging data between remote stations **1** (generally cellular telephones) and base stations **2** using RF signals. Communications are further conducted from base stations **2** through base station controllers (BSC) **4** and mobile switching center (MSC) **6** to either public switch telephone network (PSTN) **8**, or to another base station for transmission to another remote station **1**. BSCs **4** and MSC **6** typically provide mobility control, call processing, and call routing functionality.

The RF signal transmitted from a base station **2** to a set of remote stations **1** is referred to as the forward link, and the RF signal transmitted from remote stations **1** to a base station **2** is referred to as the reverse link. The IS-95 standard calls for remote stations **1** to provide telecommunications service by transmitting user data such as digitized voice data via the reverse link signal. The reverse link signal is comprised of a single traffic channel, and therefore is often referred to as a "non-coherent" signal because it does not include a pilot channel, and as such cannot be coherently demodulated.

Within the reverse link signal, user data is transmitted at a maximum data rate of 8.6 or 13.35 kbps, depending on which rate set from a set of rate sets provided by IS-95 is selected. The use of a single channel, non-coherent, reverse link signal simplifies the implementation of an IS-95

cellular telephone system by eliminating the need for synchronization between a set of remote stations 1 communicating with a single base station 2.

As mentioned above, IS-95 incorporates extensive transmit power control in order to more efficiently utilize the available RF bandwidth. In accordance with IS-95, this power control is performed by measuring the received signal strength and quality of the reverse link traffic channel when received at the base station and generating a power control command based on that measurement. The power control command is transmitted to the remote station via the forward link signal. The remote station responds to the power control command by increasing or decreasing the transmit power of the reverse link signal based on the power control command. This power control method is referred to as closed loop power control. The design of closed loop power control in a CDMA communication system is described in U.S. Patent No. 5,056,109, entitled "METHOD AND APPARATUS FOR CONTROLLING TRANSMISSION POWER IN A CDMA CELLULAR MOBILE TELEPHONE SYSTEM", which is assigned to the assignee of the present invention and incorporated by reference herein.

In IS-95 systems, the power control adjustment is performed repeatedly at rates on the order of 800 times per second in order to maintain the reverse link signal transmit power at the minimum necessary to conduct communications. Additionally, IS-95 also calls for transmit duty cycle of the reverse link signal to be adjusted in response to changes in voice activity by varying the transmit duty cycle in 20 millisecond increments. Thus, when the transmit duty cycle is lowered, the remote station transmits at either the set point, or the transmission is gated and the remote station does not transmit at all. During periods when the transmission is gated, the base station generates false power control increase commands because the reverse link signal is not detected. Since the remote station knows when its transmissions were gated, it can ignore corresponding increase commands since they are known to be false.

To satisfy the ever increasing demand to transmit digital data created by networking technologies, such as the worldwide web, a more complex higher rate multi-channel coherent reverse link signal is provided in co-pending U. S. Patent Application Serial No. 08/654,443 (the '443 Application) entitled "High Data Rate CDMA Wireless Communications System" filed May 28, 1996, assigned to the assignee of the present invention and incorporated herein by reference. The above referenced patent application describes a system wherein a set of individually gain adjusted channels are

formed via the use of a set of orthogonal subchannel codes. Data to be transmitted via one of the transmit channels is modulated with one of the subchannel codes, gain adjusted, and summed with data modulated using the other subchannel codes. The resulting summed data is modulated using a user long code and a pseudorandom spreading code (PN code) and upconverted for transmission. In particular, the above referenced patent application describes a reverse link signal made up of Walsh sequence modulated subchannels including at least one traffic subchannel, a power control subchannel, and a pilot subchannel.

A multi-channel reverse link increases flexibility by allowing different types of data to be transmitted simultaneously. Providing a pilot subchannel facilitates coherent processing of the reverse link signal at the base station which improves the performance of the link. To facilitate power control, time tracking and frequency tracking, it may be desirable to keep the average received pilot signal power to noise ratio (SNR) at a constant level. Note that in a CDMA based system, effective power control is essential to achieving a high system capacity. Usually, power control is divided into two parts, an open loop and a closed loop. In open loop power control, the mobile station measures the received forward link signal for a predetermined time period and adjusts its transmit power in response to changes in the received forward link power. The open loop power control as implemented in IS-95 systems is fairly slow and takes care of the long term channel variations (known as the corner effect). The closed loop power control as described previously is faster and tries to compensate for the effects of fading.

In IS-95 based CDMA systems, the closed loop power control is also used to drive the reverse link to a desired setpoint. For example, a frame error rate (FER) of 1% may be desired. If the FER is too high, an increase in reverse link power is necessary to reduce the error rate. On the other hand, if the FER is lower than the desired setpoint, the reverse link power can be reduced. Reducing the reverse link power reduces interference generated and thus has a direct positive effect on the other users in the system. Maximum capacity is reached in a CDMA system when every user is transmitting at the setpoint and therefore the minimum power required to achieve the desired error rate.

The operating setpoint of the system can be modified by changing the power control decision threshold at the base station. As a consequence, the total average received power of the reverse link will converge to a new value. This power control mechanism affects the total transmitted power.

However, if this technique is applied to a system employing a plurality of subchannels as provided for in the '443 Application, the relative strengths of each subchannel are not changed as the total transmit power is modified. For example, upon reaching a satisfactory power level in terms of received pilot subchannel power, any subsequent variation of transmit power to modify the received FER for a data subchannel will affect the pilot power, and vice versa. Since it is likely that different types of data which occupy separate subchannels will have different requirements, it is desirable to be able to control the transmitted power of each subchannel independently.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a power control subsystem for use in a base station of a wireless communication system in which a remote station transmits a reverse link signal comprising a plurality of subchannel signals, the power control subsystem comprising: receiver means for receiving said reverse link signal and demodulating said reverse link signal to provide said plurality of subchannel signals; quality measurement means for receiving each of said plurality of subchannel signals and for measuring the quality of each of said subchannel signals; and message generator means for generating a power control message for adjusting the transmit power of at least one of said plurality of subchannel signals whereby the transmission power of each of said plurality of subchannel signals can be independently adjusted.

According to another aspect of the invention there is provided a power control subsystem for a remote station which transmits a reverse link signal comprising a plurality of subchannel signals, said power control subsystem comprising: receiver means for receiving a power control message and for providing a plurality of gain values based on said power control message; and a plurality of gain adjust means, each of said gain adjust means being arranged to receive a corresponding subchannel signal and a corresponding gain value and to adjust the gain of said subchannel signal in accordance with said gain value, whereby the transmit power of each said subchannel signal can be independently adjusted based upon a received power control message.

According to a further aspect of the invention there is provided a method of controlling transmit power of a remote station which transmits a reverse link signal comprising a plurality of sub channel signals, the method comprising: receiving said reverse link signal; demodulating the reverse

link signal to obtain said plurality of sub channel signals; generating a power control message for use in adjusting the transmit power of at least one of said plurality of sub channel signals; and transmitting the power control message to a remote station, whereby the transmission power of each of said plurality of sub channel signals can be independently controlled.

In th following description independently controlling the transmitted power of each subchannel by a subchannel control loop is described. A transmitting station generates a channel made up of a sum of subchannels wherein each subchannel or group of subchannels is amplified with a unique gain value that is varied in accordance with subchannel power control messages from the receiving station. The receiving station generates each subchannel power control message subsequent to monitoring and calculating metrics based on that received subchannel.

BRIEF DESCRIPTION OF THE DRAWINGS

The features, objects, and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify correspondingly throughout and wherein:

FIG. 1 is a block diagram of a cellular telephone system;

FIG. 2 is a block diagram of a remote station configured in accordance with an exemplary embodiment of the present invention; and

FIG. 3 is a block diagram of a base station configured in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following described exemplary embodiment of the present invention, the subchannel control loop controls the reverse link. Therefore, the transmitting station will be referred to as the remote station and the receiving station will be referred to as the base station. Remote stations may include wireless local loop stations, portable telephones, data terminals, and the like. It is understood that this invention could also be employed on the forward link alone or on both forward and reverse links simultaneously.

In a channel containing N subchannels, the total transmitted power by a remote station, P_{tot}, is defined as the sum of the transmitted powers of each subchannel:

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$$P_{tot} = P_0 + P_1 + \ldots + P_N \quad (1)$$

A remote station can change the setpoint of a particular subchannel, subchannel i, by changing the corresponding subchannel transmitted power P_i while the operating points of the other subchannels remain unchanged.

Equation (1) can be normalized by an arbitrary power P_{ref}.

$$P_{tot} = (F_0 + F_1 + \ldots + F_N) * P_{ref} \quad (2)$$

In the exemplary embodiment, power control is accomplished by adjusting transmit power P_{ref}. Each subchannel control loop operates by adjusting a specific one or subset of F_i.

FIG. 2 depicts an exemplary remote station. In remote station **100**, a plurality of data signals **data0 - dataN** enter encoders **110A - 110N**. The encoded results are interleaved in interleavers **120A - 120N**, then modulated by unique Walsh sequences W_0 - W_N in spreaders **130A - 130N**. The outputs of multipliers **130A - 130N** are amplified in gain adjust blocks **140A - 140N** with unique gain values supplied from gain control processor **180**. Gain adjust blocks **140A - 140N** may use digital techniques or may be implemented using variable gain amplifiers, the design of both techniques is known in the art.

In the exemplary embodiment, Walsh sequence 0 (W_0) modulates a constant value to form a pilot signal. As such, in the exemplary embodiment the data input to multiplier **130A** is fixed and encoder **110A** and interleaver **120A** are not needed. The gain adjusted signals are combined in summer **150**. Summer **150** may be implemented as a digital or analog device. Although summer **150** is likely to be digital if gain adjust blocks **140A - 140N** are digital, and analog if they are analog, it is not necessary to do so. The signal made up of the sum of the individually gain adjusted data signals is amplified in gain adjust block **160** with a gain value supplied by gain control processor **180**. Gain adjust block **140A** is not essential, since pilot gain adjustments can be accomplished via gain adjust block **160**. Alternatively, gain adjust block **160** can be eliminated if the overall gain is factored into each of the subchannel gains. In either case, no loss of control is suffered since each subchannel gain as well as the overall signal gain can still be independently varied. The resultant signal from gain adjust block **160** is modulated and upconverted in transmitter **170** and then transmitted on antenna **230** through duplexer **220**. As with the other gain

adjust blocks, gain adjust **160** can be implemented using digital or analog techniques.

Forward link data from the base station, including the power control message information, is downconverted and amplified in receiver **210** via antenna **230** through duplexer **220**. The received signal is demodulated in demodulator **200**, then deinterleaved and decoded in decoder **190**. In the exemplary embodiment, demodulator **200** is a CDMA demodulator as described in the aforementioned U.S. Patent Nos. 4,401,307 and 5,103,459. Subchannel power control messages from the base station are separated from the forward link data decoded by decoder **190** in gain control processor **180**.

These messages independently control the gain values in gain adjust blocks **140A - 140N** and **160**. There are a number of ways for the gain values to be adjusted. For example, the subchannel power control message can consist of N bits, wherein each of the N bits directs a corresponding subchannel to increase or decrease its transmitted power. In response to this message, each gain value is increased or decreased by a predetermined amount that can be used for all subchannels or can be unique for each subchannel. Alternatively, the subchannel power control message can contain N binary sequences indicating the gain values or indicating the amount of change to the gain values. The control messages can independently control each gain value or a group of gain values, and can employ a combination of techniques for each.

FIG. 3. depicts an exemplary base station. In base station **300**, a signal containing the sum of all transmitted signals from remote stations operating in the system enters through antenna **310** and is downconverted and amplified in receiver **320**. PN demodulator **330** extracts the set of signals transmitted by a particular remote station, remote station **100** for example. The PN demodulated signal is directed to a plurality of Walsh demodulators **340A - 340N**. Each Walsh demodulator demodulates a corresponding subchannel of the signal sent by remote station **100**.

In the exemplary embodiment, the subchannels as demodulated by Walsh demodulators **340A - 340N** can be deinterleaved and decoded in decoders **350A - 350N**. The data from decoders **350A - 350N** is delivered to comparator **370**. A useful metric for comparator **370** to calculate is that of frame error rate (FER). The frame error rate of each subchannel can be compared to a FER threshold for that subchannel as provided by threshold generator **380**. If the frame error rate of a subchannel is lower than necessary for the desired communication quality, the power in that subchannel can be

reduced. Conversely, if the frame error rate of a subchannel is too high, that subchannel needs to have its power increased.

In an alternative embodiment, the energy in each subchannel signal is summed in accumulators **360A - 360N**. The energy results are delivered to comparator **370**. Receiver **320** typically contains automatic gain control circuitry (AGC), which normalizes the in-band energy to a predetermined level. Parameters associated with the AGC can be delivered to comparator **370** to assist in normalizing energy values for comparison. Comparator **370** compares the energy received in each subchannel with an energy threshold for that channel as determined by threshold generator **380**. The energy thresholds are calculated to ensure a certain quality of service on the respective subchannel. Each subchannel's power can be adjusted based on the comparison. The power can be reduced if the threshold is exceeded and reduced if the threshold is not exceeded. Moreover, the two embodiments can work in conjunction with one another by permitting the energy thresholds to be varied in response to the frame error rate or other signal quality metric.

Many other alternatives are envisioned for comparison in comparator **370**. When decoders **350A - 350N** use the Viterbi algorithm, Viterbi decoder metrics can be provided for comparison. Further examples include comparison of symbol error rate instead of frame error rate and computation of a cyclic redundancy check (CRC). The thresholds can be signaled to threshold generator **380** by base station controller **4** as shown in FIG. 1, or they can be calculated in threshold generator **380** itself.

In the exemplary embodiment, comparator **370** makes a determination based on the received subchannels whether or not to increase or decrease the power level of each of the subchannels. Based on that determination, message generator **390** creates a power control message to be sent to the remote station to modify any subchannels, if necessary. The power control messages can be transmitted as signaling data or punctured into the data stream as described in IS-95, or any other method of signaling capable of relaying the message to the mobile station. As discussed previously, the message can be a simple up or down command per subchannel or as complicated as sending the exact gain values for each. Furthermore, each subchannel can be controlled independently, or alternatively, subchannel power control messages can control groups of subchannels. The power control message is modulated in modulator **400**, upconverted and amplified in transmitter **410** and transmitted to remote station **100** via antenna **420**. Remote station **100** modifies the gain value

associated with each subchannel as described previously, and thus the subchannel control loop is closed.

In an alternative embodiment, the gain values for gain adjust blocks 140A - 140N can be calculated in an open loop manner. A predetermined gain calculation algorithm in gain control processor 180 can be used to calculate the individual gain adjust values based on the received energy of the forward link signal. For example, different subchannels are likely to have different coding for error correction and thus the error rates will vary for a given drop in received power due to a fade. Empirical studies can be used to develop the predetermined gain calculation algorithm.

In another alternative embodiment, if both forward and reverse links employ this invention, open loop calculations of received energy of a forward link subchannel can be used to adjust the gain of a corresponding reverse link subchannel, and vice versa. In situations where there is symmetry or partial symmetry with respect to the forward and reverse links, the received energy in a subchannel can be used in calculations for determining the power level of the corresponding transmit subchannel. A combination of open and closed loop techniques can also be employed.

The previous description of the preferred embodiments is provided to enable any person skilled in the art to make or use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

WE CLAIM:

CLAIMS

1. A power control subsystem for use in a base station of a wireless communication system in which a remote station transmits a reverse link signal comprising a plurality of subchannel signals, the power control subsystem comprising:

receiver means for receiving said reverse link signal and demodulating said reverse link signal to provide said plurality of subchannel signals;

quality measurement means for receiving each of said plurality of subchannel signals and for measuring the quality of each of said subchannel signals; and

message generator means for generating a power control message for adjusting the transmit power of at least one of said plurality of subchannel signals whereby the transmission power of each of said plurality of subchannel signals can be independently adjusted.

2. The power control subsystem of Claim 1 wherein said receiver means comprises:

PN demodulator means for demodulating said reverse link signal in accordance with a pseudorandom noise (PN) sequence to provide a remote station signal; and

a plurality of orthogonal demodulation means each of which is receiving said remote station signal and for demodulating said remote station signal in accordance with an orthogonal demodulation sequence to provide a corresponding one of said subchannel signals.

3. The power control subsystem of Claim 1or 2 wherein said quality measurement means comprises:

a plurality of accumulator means, each of said accumulators for receiving a corresponding one of said subchannel signals and for accumulating the energy of said subchannel signal for a predetermined period of time to provide an accumulated subchannel energy; and

comparator means for receiving said accumulated subchannel energies and for comparing each of said accumulated subchannel energies with a corresponding threshold value of a plurality of threshold values.

4. The power control subsystem of Claim 1, 2 or 3 wherein said quality measurement means comprises:

plurality of decoder means, each of said decoder means for receiving a corresponding subchannel signal and for determining the existence of frame errors in said subchannel signal; and

comparator means for comparing a frame error rate based on said determined frame errors with a frame error rate threshold.

5. The power control subsystem of Claim 3 or 4 wherein said quality measure means further comprises:

threshold generator means for generating said plurality of threshold values in accordance with a measured frame error rate for each of said subchannels.

6. The power control system of any preceding Claim wherein said power control message comprises:

a plurality of bits, wherein each bit directs one of said plurality of subchannels to increase or decrease the transmit power of said subchannel by a predetermined amount.

7. The power control system of any preceding Claim wherein said power control message comprises:

a plurality of gain values, wherein each gain value is applied to one of said plurality of subchannels to control the transmit power of said subchannel.

8. The power control system of any preceding Claim wherein said power control message comprises:

a plurality of values, wherein each value is made up of more than one bit and fewer than the number required to determine the entire gain value, and each of said plurality of values directs one of said plurality of subchannels to increase or decrease the transmit power of said subchannel by said value multiplied by a predetermined amount.

9. The power control system of any preceding Claim further comprising:

a modulator for modulating said power control message in accordance with a modulation format.

10. The power control system of Claim 9 wherein said modulator comprises:

a modulator which modulates in accordance with a CDMA format.

11. The power control subsystem of Claim 2 wherein said quality measurement means comprises:

a plurality of accumulator means, each of said accumulators for receiving a corresponding one of said subchannel signals and for accumulating the energy of said subchannel signal for a predetermined period of time to provide an accumulated subchannel energy; and

comparator means for receiving said accumulated subchannel energies and for comparing each of said accumulated subchannel energies with a corresponding threshold value of a plurality of threshold values.

12. The power control subsystem of Claim 2 wherein said quality measurement means comprises:

plurality of decoder means, each of said decoder means for receiving a corresponding subchannel signal and for determining the existence of frame errors in said subchannel signal; and

comparator means for comparing a frame error rate based on said determined frame errors with a frame error rate threshold.

13. The power control subsystem of Claim 11 wherein said quality measure means further comprises:

threshold generator means for generating said plurality of threshold values in accordance with a measured frame error rate for each of said subchannels.

14. The power control system of Claim 2 wherein said power control message comprises:

a plurality of bits, wherein each bit directs one of said plurality of subchannels to increase or decrease the transmit power of said subchannel by a predetermined amount.

15. The power control system of Claim 2 wherein said power control message comprises:

a plurality of gain values, wherein each gain value is applied to one of said plurality of subchannels to control the transmit power of said subchannel.

16. The power control system of Claim 2 wherein said power control message comprises:

a plurality of values, wherein each value is made up of more than one bit and fewer than the number required to determine the entire gain value, and each of said plurality of values directs one of said plurality of subchannels to increase or decrease the transmit power of said subchannel by said value multiplied by a predetermined amount.

17. The power control system of Claim 2 further comprising:

a modulator for modulating said power control message in accordance with a modulation format.

18. The power control system of Claim 17 wherein said modulator comprises:

a modulator which modulates in accordance with a CDMA format.

19. A power control subsystem for a remote station which transmits a reverse link signal comprising a plurality of subchannel signals, said power control subsystem comprising:

receiver means for receiving a power control message and for providing a plurality of gain values based on said power control message; and

a plurality of gain adjust means, each of said gain adjust means being arranged to receive a corresponding subchannel signal and a corresponding gain value and to adjust the gain of said subchannel signal in accordance with said gain value, whereby the transmit power of each said subchannel signal can be independently adjusted based upon a received power control message.

20. A method of controlling transmit power of a remote station which transmits a reverse link signal comprising a plurality of sub channel signals, the method comprising:

receiving said reverse link signal;

demodulating the reverse link signal to obtain said plurality of sub channel signals;

generating a power control message for use in adjusting the transmit power of at least one of said plurality of sub channel signals;

and transmitting the power control message to a remote station, whereby the transmission power of each of said plurality of sub channel signals can be independently controlled.

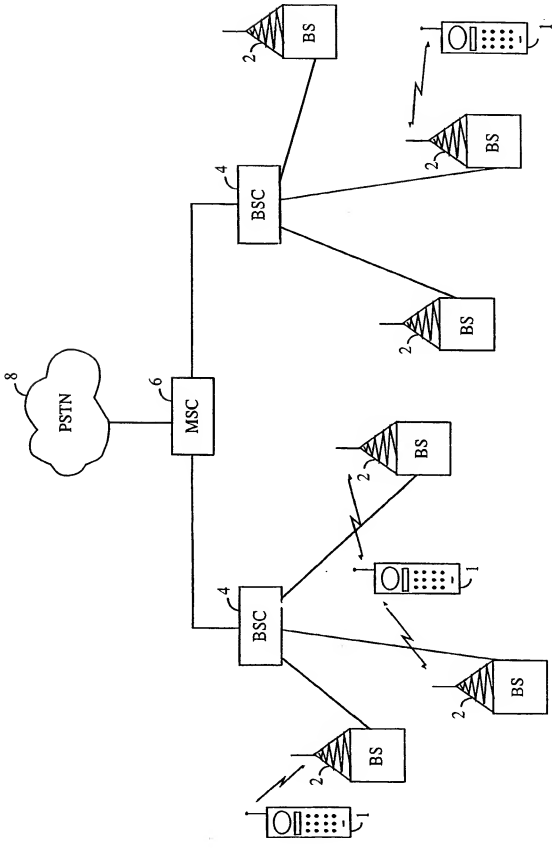

FIG. 1

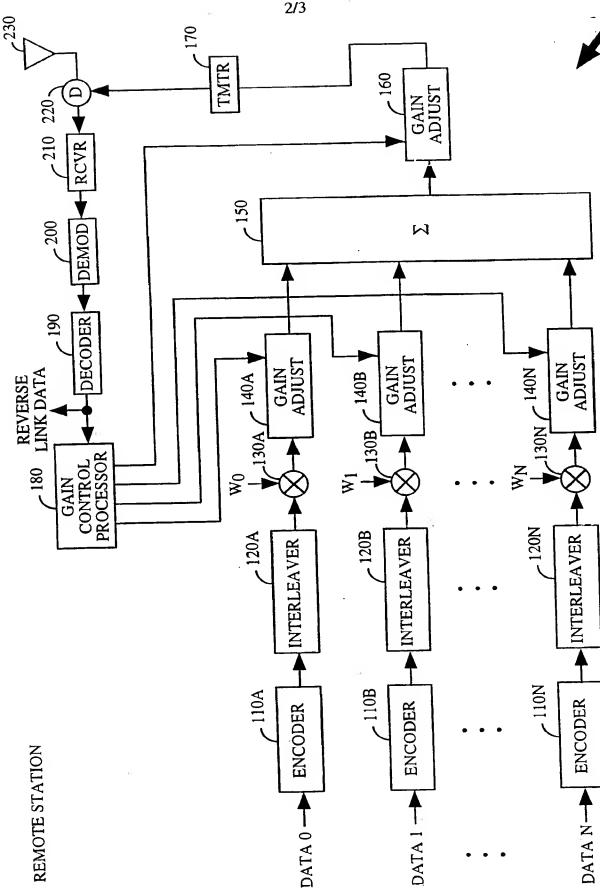
REMOTE STATION
DATA 0
DATA 1
DATA N
ENCODER
110A
110B
110N
INTERLEAVER
120A
120B
120N
130A
130B
130N
W_0
W_1
W_N
GAIN ADJUST
140A
140B
140N
Σ
150
GAIN ADJUST
160
TMTR
170
GAIN CONTROL PROCESSOR
180
REVERSE LINK DATA
DECODER
190
DEMOD
200
RCVR
210
D
220
230
100

FIG. 2

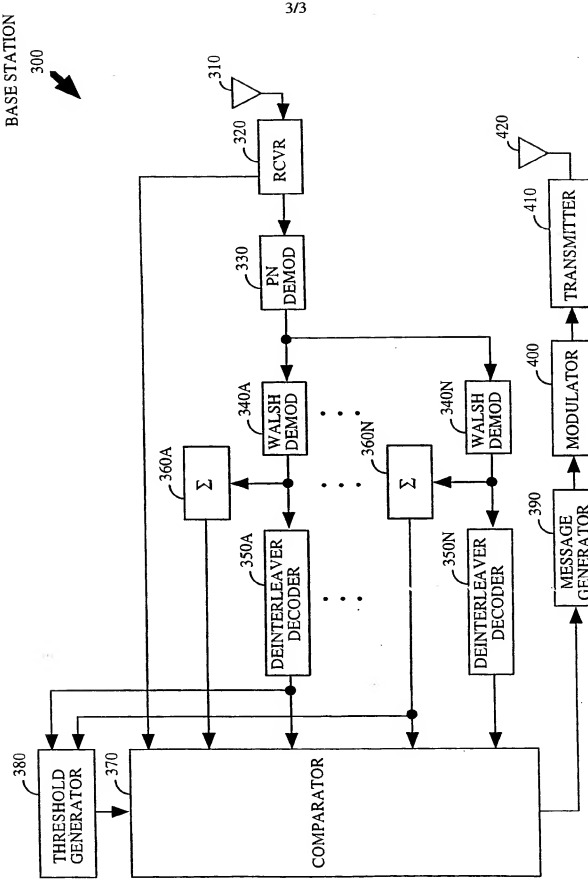

FIG. 3

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(71) Applicant: QUALCOMM INCORPORATED [US/US]; 6455 Lusk Boulevard, San Diego, CA 92121 (US).

(72) Inventors: WILLENEGGER, Serge; Vallon 14, CH-1400 Yverdon-Les-Bains (CH). JOU, Yu-Cheun; 9979 Riverhead Drive, San Diego, CA 92129 (US).

(74) Agents: MILLER, Russell, B. et al.; Qualcomm Incorporated, 6455 Lusk Boulevard, San Diego, CA 92121 (US).

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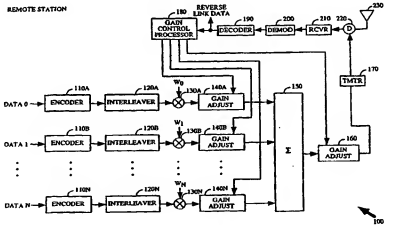

(57) Abstract

A power control subsystem (100) for a remote station (1) which transmits a reverse link signal comprising a plurality of subchannel signals, the power control subsystem comprising a receiver (210) and plural gain adjusters (140A, 140B, 140N). The receiver (210) is arranged to receive a power control message and to provide a plurality of gain values based on said power control message. Each of said gain adjusters is arranged to receive a corresponding subchannel signal and a corresponding gain value and to adjust the gain of said subchannel signal in accordance with said gain value, whereby the transmit power of each said subchannel signal can be independently adjusted based upon a received power control message. Thus, when a transmitting station (2) generates a channel made up of a sum of subchannels, each subchannel or group of subchannels is amplified with a unique gain value that is varied in accordance with subchannel power control messages. The subchannel power control messages are generated subsequent to monitoring and calculating metrics based on that received subchannel.

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INTERNATIONAL SEARCH REPORT

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A CLASSIFICATION OF SUBJECT MATTER

H 04 B 7/005

According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)

H 04 B,H 04 J,H 04 L

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5056109 A (QUALCOMM INCORPORATED) 08 October 1991 (08.10.91), fig. 1,3-6, column 3, lines 60-65, column 9, lines 30-40, column 12, lines 36-68, column 14, lines 42-62, column 16, lines 3-51 (cited in the application). --	1-3, 6-11, 17-20
A	GB 2300546 A (SAMSUNG ELECTRONICS) 06 November 1996 (06.11.96), fig. 8, abstract. --	1,19, 20
A	EP 0682418 A2 (NTT MOBILE COMMUNICATIONS NETWORK) 15 November 1995 (15.11.95),	1,6,7, 9,10, 19,20

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer DRÖSCHER e.h.

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	fig. 12, column 12, lines 25-50.	
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ANHANG

zum internationalen Recherchenbericht über die internationale Patentanmeldung Nr.

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PCT/US 98/02773 SAE 185276

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